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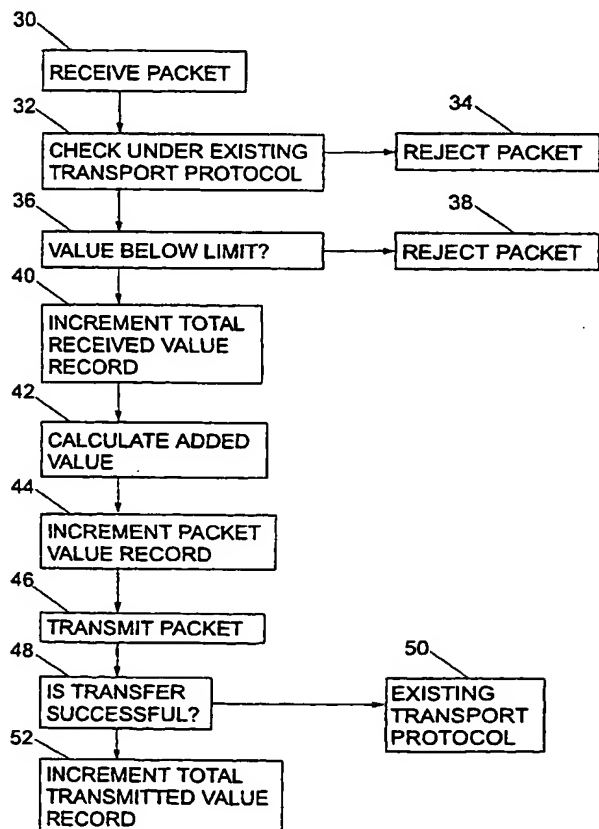
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(54) Title: COMPUTER NETWORK PAYMENT SYSTEM



(57) Abstract: A method of electronic payment for data transferred across a computer network from a server (26) to a client (20) by means of at least one router (22, 24) which forwards data. An electronic data request is sent from the client to the server via one or more routers. The server (26) then sends electronic data (8) to the client (20) via one or more routers in response to said electronic data request. The electronic data is sent via a packet transfer protocol, in which each packet of data (10) has associated with it a data field (5) containing a value which represents the commercial value of the requested data (8). Each router (22, 24) receives an incoming data packet (10), reads the value in the data field (5) associated with the incoming data packet, calculates a new value based on the read value and the cost of forwarding the data packet, and forwards the data packet (10) with the new value in the associated data field (5). Each router can check whether the value in the data field (5) associated with the incoming data packet falls within predefined "parameters".

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1     **Computer network payment system**

2

3     The invention relates to a system and method for  
4     transferring payments corresponding to the supply of  
5     information over a computer network. In particular the  
6     invention relates to a system and method for  
7     transmitting payment information between servers and  
8     clients by means of a hardware infrastructure of linked  
9     routers and by means of a specially adapted protocol.

10    The protocol used by the system and method of the  
11    invention is referred to herein as "Packet Tariff  
12    Protocol" or "PTP". It is to be understood that the  
13    term PTP when used in the following description should  
14    be taken to mean a protocol adapted for use with  
15    systems which transfer data in packets between servers  
16    and clients, the protocol enabling the transmittal of  
17    payment information between the servers and clients.

18

19    It is also to be understood that the term "packet" when  
20    used in the following description should be taken to be

1 a generic term, meaning any discrete package or block  
2 of data that is described by any particular protocol,  
3 as appropriate to any particular communication layer.  
4 For the purposes of the following description the term  
5 "packet" should therefore include message, segment,  
6 datagram, frame and any other term which by definition  
7 or common usage is accepted as meaning a discrete  
8 package or block of data in the context of a specific  
9 protocol, as appropriate to any particular  
10 communication layer.

11

12 Access to the Internet is freely available everywhere  
13 and the advent of e-commerce, or electronic trading, is  
14 set to revolutionize the way that business is done.  
15 However there remains a requirement for effective  
16 trading of information itself. As the infrastructure  
17 and available bandwidth expand to appropriate levels,  
18 the world will become a single, on-line, global,  
19 multimedia library. All public domain information will  
20 be available to anyone with a network connection, via a  
21 simple, easy to use interface, analogous to today's  
22 Web browser application. In addition, suitable tools  
23 will be developed to manage the information and tailor  
24 all that is available to suit the particular needs of  
25 each individual. There are two major consequences of  
26 this, as follows.

27

28 Firstly, holding information locally will become  
29 redundant. This means that books, CDs, prerecorded  
30 videotapes and so on will eventually not be required.  
31 When information is sufficiently cheap and reaches the  
32 necessary levels of specificity and availability, there

1 will be no point in individuals holding local copies of  
2 the information, in the form of books, CDs, tapes etc.,  
3 that will quickly go out of date. They will simply  
4 access the latest, updated information from its  
5 original source or retrieve other data (noting that any  
6 digital multimedia information is fundamentally just  
7 data) from on-line archives.

8

9 Secondly, broadcast media will also become redundant.  
10 Radio stations, TV channels, newspapers and journals  
11 will no longer serve any purpose. Once again, highly  
12 sophisticated information management tools will  
13 retrieve information from the massive range of  
14 disparate original sources that will come into  
15 existence, with the output collated, rationalized and  
16 customized to match the particular requirements of each  
17 networked individual.

18

19 These changes lie in the future, but are inevitable,  
20 and are likely to result in commercial upheaval and  
21 colossal social changes. At present, however, there  
22 remains a pressing need for a consistent and  
23 appropriate system or method to permit the  
24 implementation of this trade in information. The  
25 system must conform to, and operate under, the  
26 conditions that exist within free-market commercial and  
27 national economies. It is the development of a  
28 proposed solution to this problem which is addressed by  
29 the present invention.

30

31 The PTP or "Packet Tariff Protocol" is an element  
32 within an effective system for digital networks at

1 packet level. The protocol is envisaged as, but not  
2 limited to, an evolution of the existing TCP/IP  
3 (Transmission Control Protocol/Internet Protocol)  
4 standard that forms the core of the Internet as it  
5 presently exists. However PTP is not limited to TCP/IP  
6 applications, but can be used in any environment where  
7 there is transfer of data in distinct pieces or  
8 packets, for example WAP (Wireless Application  
9 Protocol), UMTS (Universal Mobile Telecommunications  
10 System), GPRS (General Packet Radio Service) or others.

11

12 According to a first aspect of the present invention  
13 there is provided a method of electronic payment for  
14 data transferred across a computer network containing  
15 at least one client, at least one server and at least  
16 one router which forwards data, the method comprising  
17 the steps of:

18 sending an electronic data request from a client  
19 to a server via one or more routers; and

20 sending electronic data from said server to said  
21 client via one or more routers in response to said  
22 electronic data request, said electronic data having  
23 associated with it a data field containing a value  
24 which represents the commercial value of the data  
25 contained within the electronic data.

26

27 Preferably the electronic data is transmitted in the  
28 form of packets. Preferably each of said one or more  
29 routers receives an incoming data packet, reads the  
30 value in the data field associated with the incoming  
31 data packet, calculates a new value based on the read  
32 value and the cost of forwarding the data packet, and

1 forwards the data packet with the new value in the  
2 associated data field.

3

4 Preferably each of said one or more routers checks  
5 whether the value in the data field associated with the  
6 incoming data packet falls within predefined parameters  
7 and rejects the packet if the value falls outside the  
8 predefined parameters. The parameters may depend on  
9 the source of the data packet or the originator of the  
10 data request.

11

12 The electronic data request may also have associated  
13 with it a data field containing a value which  
14 represents the commercial value of the data contained  
15 within the electronic data request.

16

17 Preferably total accumulated values for transactions  
18 between routers or between routers and servers/clients  
19 are recorded. These total values may be used as the  
20 basis for payments between the operators and/or users  
21 of the routers, servers or clients. Periodic clearance  
22 payments may be made between the operators and/or users  
23 of the routers, servers or clients, the clearance  
24 payments corresponding to the total accumulated values.

25

26 According to a second aspect of the present invention  
27 there is provided a system of electronic payment for  
28 data based on a hardware infrastructure of linked  
29 routers, data providers and data users, comprising:

30 at least one client;

31 at least one server for providing electronic data  
32 in the form of data packets in response to a request

1 from a client and having its operation governed by a  
2 server protocol which causes each data packet sent by  
3 the server to have associated with it a data field  
4 representing the value of the data contained within the  
5 packet;

6 at least one router linked by a hardware  
7 infrastructure to said server and said client and  
8 having its operation governed by a routing table and a  
9 router protocol;

10 whereby the router protocol causes each router to  
11 add commercial value to the packet by forwarding it in  
12 accordance with the routing table and to update the  
13 value contained in the data field within the packet to  
14 reflect this added commercial value.

15

16 Preferably the router protocol also includes procedures  
17 for rejecting individual packets in accordance with  
18 pre-defined parameters related to the value of each  
19 packet on receipt.

20

21 According to a third aspect of the invention there is  
22 provided a method of electronic payment for data  
23 transferred across a computer network containing at  
24 least one client, at least one server and at least one  
25 part of the network which forwards data, the method  
26 comprising the steps of:

27 sending an electronic data request from a client  
28 to a server via the part of the network; and

29 sending electronic data from said server to said  
30 client via the part of the network in response to said  
31 electronic data request, said electronic data having  
32 associated with it a data field containing a value



1 which represents the commercial value of the data  
2 contained within the electronic data.

3

4 Preferably the electronic data is transmitted in the  
5 form of packets. Preferably the part of the network  
6 has an associated data processor which reads the value  
7 in the data field associated with an incoming data  
8 packet received by the part of the network, calculates  
9 a new value based on the read value and the cost of  
10 forwarding the data packet, and forwards the data  
11 packet with the new value in the associated data field.

12

13 The data processor may check whether the value in the  
14 data field associated with the incoming data packet  
15 falls within predefined parameters and rejects the  
16 packet if the value falls outside the predefined  
17 parameters.

18

19 According to a fourth aspect of the invention there is  
20 provided a method of electronic payment for requested  
21 data transferred across a computer network containing  
22 at least one client, at least one server and at least  
23 one router which forwards data, in which the requested  
24 data is sent from said server to said client in the  
25 form of a packet,

26 wherein said packet comprises a packet header and  
27 packet data,

28 the packet data containing the requested data, and

29 the packet header containing one or more address  
30 fields containing address information relating to the  
31 client and/or server and a data field containing a

1 value which represents the commercial value of the  
2 requested data contained within the packet data.

3

4 Preferably the data is sent via the router which reads  
5 the value in the data field of the incoming data packet  
6 received by the router, calculates a new value based on  
7 the read value and the cost of forwarding the data  
8 packet, writes the new value to the data field, and  
9 forwards the data packet with the new value in the data  
10 field.

11

12 The invention will now be described, by way of example  
13 only, with reference to the accompanying figures,  
14 where:

15

16 Fig. 1 is a schematic representation of a typical  
17 generic form of a digital data packet under the system  
18 of the invention;

19

20 Fig. 2 is a schematic representation of a fragment of a  
21 network; and

22

23 Fig. 3 is a flow chart showing the operation of a  
24 network router under the system according to the  
25 invention.

26

27 The invention can best be understood by considering the  
28 metaphor of the supply chain with associated added  
29 value at each stage. In other words, at each step in  
30 the process to supply the information, value is added  
31 over and above the intrinsic value of the information.

32 Therefore, an additional cost is associated with the

1 information at each stage, until it reaches its  
2 ultimate destination. In practice, this is achieved by  
3 the incorporation of a "value" field into each data  
4 packet, allied with network protocol extensions to  
5 implement and utilize this field in the packet. This  
6 is applied in a way that ultimately results in the cost  
7 of providing the intrinsic information and the cost of  
8 providing the transport service being enumerated and  
9 accrued in the value field. These costs are thus  
10 accounted for within the same system that actually  
11 provides the data transport service, so that the supply  
12 chain and the value chain are both incorporated into  
13 the network protocols.

14

15 The value field may be augmented with a "priority"  
16 field, along the lines that have already been proposed  
17 by other bodies as part of existing technical  
18 specifications. Within this framework though, the  
19 priority field can additionally be used as part of the  
20 commercial system if required, so that different  
21 services can incur different costs although they may  
22 share the same hardware and network infrastructure. In  
23 some prior art developments, the "priority" field of a  
24 data packet has evolved to serve a more advanced  
25 purpose, and the field contains a code that indicates  
26 how data should be handled, according to its  
27 characteristics. For example, transmission of data  
28 that is part of a video stream might not be re-tried if  
29 it fails first time, since a degraded video output is  
30 considered to be more useful to the ultimate end-user  
31 than a pause to wait for all the information to achieve  
32 perfect reproduction. In contrast, a file transfer can

1 usually wait for the availability of network capacity,  
2 but must ultimately be one hundred percent complete,  
3 accurate and checked if it is to be of practical use.

4  
5 In the system according to the invention, data is  
6 transferred between servers and clients in packets.  
7 Fig. 1 shows the typical generic form of a digital data  
8 packet under the implementation of PTP.

9  
10 The packet 10 is simply data in a mutually understood  
11 format. In the example of Fig. 1, it is divided into  
12 three sections 1, 2, 3. Each section may be further  
13 divided into multiple fields, as described below. The  
14 packet header 1 contains general fields 4 for  
15 addressing information or other information and also  
16 contains a value field 5. The number of general fields  
17 4 depends on the protocol used, and it is to be  
18 understood that the number of general fields 4 and the  
19 position of the value field 5 within the packet header  
20 1 may vary. The packet data 2 contains the data 8 and  
21 follows the packet header 1. The packet tail 3 follows  
22 the packet data 2 and is optional, but would typically  
23 contain a field 6 containing the checksum for the  
24 packet, or similar error detection information, and may  
25 contain other general fields 7. Again it is to be  
26 understood that the number of general fields 7 and the  
27 position of the checksum field 6 within the packet tail  
28 3 may vary. It is to be understood that the value  
29 field may be in any position within the packet, for  
30 example within the payload or packet data 2, or within  
31 the packet tail 3.

32

1 Each data packet 10 includes a value field 5, which  
2 contains information about the intrinsic value of the  
3 data 8 contained within the packet, and which  
4 accumulates the charges made for each step in the  
5 provision of the service for supplying that data packet  
6 to its ultimate recipient. As an example, this  
7 aggregated overall worth may be measured in Network  
8 Credit Units (NCU's).

9

10 For the purpose of applying tariffs, the network system  
11 is considered to consist of "servers", "routers" and  
12 "clients" although in practice a single machine or even  
13 a single software application may fulfil more than one  
14 of these functions at different times. For example, a  
15 router can be considered to be acting as a client to  
16 many servers and as a server to many clients, as  
17 defined by the routing tables to which it adheres at  
18 any particular moment in time.

19

20 Fig. 2 is a diagram showing a network fragment. Under  
21 the system of the invention it may operate in the  
22 following manner. The web client 20 operated by the  
23 ultimate end user requests information in the form of a  
24 message that passes through router (N) 22 at the  
25 internet service provider (ISP) connection and accrues  
26 added value as a result of the action of the transport  
27 service. The message subsequently passes through a  
28 number of intermediate routers (not shown) and finally  
29 through router (A) 24 and accrues more added value for  
30 the extra transport service. The intermediate routers  
31 and routers (A) and (N) form the network infrastructure  
32 carrying the data. The message then arrives at the web

1 server 26, which responds by initiating a data stream.  
2 The web server 26 is operated by a content provider.  
3 The packets of this data stream typically have  
4 intrinsic value, associated with the information that  
5 they contain, the information being provided or sold by  
6 the content provider. The appropriate component of  
7 this intrinsic value is recorded in each packet. The  
8 packets then pass back via router (A) 24 and have the  
9 associated value of the transport service added to  
10 them. Similarly, router (N) 22 passes the data stream  
11 and adds further value to the packets for the service  
12 provided. The information finally arrives at the web  
13 client 20, as required.

14

15 For each machine on the network, the net values of  
16 packets received and transmitted via each hardware  
17 connection can then be calculated. These values are  
18 reconciled by the owners of all the machines involved,  
19 as the basis for assessing the economic value of the  
20 services provided and calculating the commensurate hard  
21 currency exchanges required. This process is described  
22 in more detail below.

23

24 In accordance with the PTP idea, the web client 20, or  
25 any software application functioning as a client,  
26 maintains the right to reject individual packets if  
27 they are deemed "too expensive" by some criteria,  
28 without assuming their associated notional cost.  
29 Additional control is maintained by monitoring the  
30 value of incoming packets in real time, typically by  
31 summing the total value arriving in the last second  
32 and/or minute and/or hour and/or other time interval,

1 as required. This might, for example, be depicted by a  
2 meter representation or bar indicator on a network  
3 terminal screen. Over a short time period, of the  
4 order of a few seconds or so, it might be acceptable to  
5 have a large amount of data arriving with a large value  
6 at a high rate of value accrual, for example when  
7 downloading a software application. However over a  
8 longer time period, of the order of an hour or so, a  
9 high rate of value accrual might be unacceptable while  
10 it might be acceptable to have a continuous stream of  
11 data arriving with a smaller value, for example when  
12 downloading a movie or video in real time. A meter  
13 representation could also apply to an Internet  
14 telephone, and the system could show the cost of a call  
15 as it takes place, rather than the owner subscribing to  
16 the service on a predetermined tariff scheme. This  
17 does not preclude a service provider agreeing to absorb  
18 the fluctuations in cost and passing on packets at  
19 agreed rates if such a service is desired by clients on  
20 the network. This might be appropriate, for example,  
21 if a client actually desired predetermined costs for  
22 use of the system, e.g. for budgeting purposes.

23

24 The invention is now described in more detail. For the  
25 purposes of the description herein, a packet originates  
26 from a server that acts as a "content provider", i.e.  
27 it is the source of the data or information contained  
28 within the packet that is to be transferred. This  
29 piece of information and the service of providing it  
30 both have some inherent worth and this worth can be  
31 enumerated and written in the value field of the  
32 packet. This is the first element of the system of the

1 present invention, in that content providers can attach  
2 a value to the information that they provide and,  
3 further, they can assert the claim to that value along  
4 the same delivery channel as that by which the  
5 information itself is supplied. On receipt of the  
6 packet, the client (or router acting as a client) can  
7 accept the packet or reject it. The control system  
8 which makes the decision and determines the outcome of  
9 this choice is described later. It is of importance,  
10 because information cannot meaningfully be returned  
11 once received.

12

13 Assuming that a router receives and accepts a packet,  
14 it then acts in its role as a server and forwards it in  
15 accordance with the routing tables it currently holds.  
16 It should be noted that this always entails sending the  
17 packet down a physical data connection of some sort.  
18 The network is defined by the routing tables, but  
19 always has a physical existence as data conduits  
20 between machines. In the system of the invention, the  
21 routing machine defines the worth associated with the  
22 action of passing a packet from one machine to the  
23 next. It might be a fixed rate, or it might be  
24 dependent on the priority of the packet or on some  
25 other parameters (e.g. network loading, time of day,  
26 physical distance between machines, available  
27 bandwidth, ownership of network infrastructure, etc.).  
28 The important point is that this evaluation can be  
29 resolved by the router (probably as part of its routing  
30 software) as it passes the packet and that the outcome  
31 of this calculation is added to the value field of the  
32 packet in transition (i.e., before it is forwarded).



1 This is the second element of the system of the present  
2 invention, in that network infrastructure providers can  
3 attach a value to the service of transporting  
4 information and, further, they can assert the claim to  
5 that value along the same delivery channel as that by  
6 which the information itself is supplied. It is also  
7 necessary for each machine to accumulate the total  
8 number of NCU's it receives from each physical  
9 connection and the total number of NCU's it dispatches  
10 to each physical connection, excluding those attributed  
11 to packets that are subsequently rejected. It should  
12 also be noted that physical connections for the receipt  
13 of packets are considered to be distinct from physical  
14 connections for the dispatch of packets, even though  
15 they might be manifested in the same piece of cabling.

16

17 Under these conditions, the number of NCU's transmitted  
18 from the machine at one end of a physical connection  
19 should agree with the number of NCU's accepted by the  
20 machine at the other end. These machines may be owned  
21 by different organizations but, on the basis that they  
22 agreed to make the trades, they should be reasonably  
23 expected to have mutual interest in ensuring accuracy  
24 in accounting. A commercial analogy for this would be  
25 a deal done on an "open outcry" trading floor, in which  
26 two parties agree a deal by signals and each makes a  
27 record of it independently. The independent records  
28 are reconciled at a later stage but, since both parties  
29 agreed the initial deal, both are assumed to have an  
30 interest in making sure that it is recorded accurately.  
31 The analogy goes further, since any party that  
32 establishes a reputation for not recording deals

1 accurately will simply find it impossible to establish  
2 or maintain any profitable trades.

3

4 Within this protocol, any recipient reserves the right  
5 to reject any packet. This rejection includes refusal  
6 to accept the debt associated with receipt of the  
7 packet. The most probable reason for this is that the  
8 packet is deemed by some criteria to be "too

9 expensive". This act of rejection is an important part  
10 of the protocol and therefore warrants detailed

11 discussion. As discussed above, once data is received  
12 it cannot be meaningfully returned, since it is not a  
13 physical object. On first inspection, then, it seems  
14 that there would be a propensity to defraud suppliers  
15 by rejecting packets (and therefore the liability to  
16 pay for them) whilst still forwarding the data and  
17 charging for it. However, the post-receipt rejection  
18 process is vital to remove completely the possibility  
19 that single "rogue" packets of massive value are

20 foisted on unsuspecting recipients. The reason that an  
21 immediate breakdown of the system according to the  
22 invention does not follow is because successful trading  
23 requires streams of many packets of modest value to be  
24 passed through the network. In the proposed scenario,  
25 the "catch 'em once" price-value combination is  
26 excluded by this ability to refuse to pay for  
27 excessively costly packets. This means that a  
28 sustainable and profitable trade will only occur with  
29 the transmission of an ongoing packet stream.

30

31 This "reject" aspect of the system according to the  
32 invention may best be understood by considering a "sale

1 or return" analogy. A producer (content provider)  
2 creates a product (data/information) and delivers it to  
3 a reseller (router) at some cost (the value in NCU's).  
4 The reseller (router) either accepts it, on the basis  
5 that it can be sold on (forwarded to another router or  
6 an end client) at a marked up price (an addition to the  
7 value in NCU's) or, alternatively, rejects it. The  
8 producer (content provider) monitors the rejections of  
9 the reseller (router) and decides on the basis of this  
10 information whether or not to continue trading and, if  
11 so, what price structure to apply. Hence, the choice  
12 of acceptance or rejection of a packet is effectively a  
13 "sale or return" of the data, since keeping occasional  
14 packets without paying for them is of little economic  
15 value. In practice, it will rapidly become the case  
16 that meaningful trade in packet streams allied to  
17 competitive pricing is the only way to maintain  
18 profitable transactions.

19  
20 Termination criteria are based upon single packet costs  
21 and the cost accumulations of packets over selected  
22 time intervals. Hence termination requests are issued  
23 if any single packet exceeds the NCU threshold or if  
24 the limits for NCU's per second, minute, hour, day  
25 and/or other time interval are exceeded. The cut-off  
26 levels are best kept confidential to avoid prices being  
27 bumped up to the maximum that would be accepted,  
28 although such information could be shared with trusted  
29 counterparts in an attempt to reject packets deemed too  
30 costly at an earlier stage. Note that single-packet  
31 rejection is the only rejection where packets are not  
32 paid for, other termination is simply a request to

1   cease supplying data. Data received before supply  
2   terminates are still paid for, subject to single packet  
3   criteria.

4

5   Conversely, the value attributed to data by content  
6   providers could be freely advertised. This would make  
7   competition between content providers more effective  
8   and would also highlight expensive transport routes,  
9   since the value of the packet received would have had  
10   risen unacceptably when compared to the initial value  
11   advertised by the content provider. Furthermore, data  
12   network routing should become an extremely efficient  
13   market because data transmission networks can be  
14   reconfigured so easily and pricing structures changed  
15   so readily. This should result in perfect competition,  
16   evolving to satisfy the laws of supply and demand in a  
17   free market.

18

19   The final element of the system according to the  
20   invention is achieved by converting the residual  
21   difference in NCU's exchanged between a pair of  
22   machines over some physical connection into a payment  
23   in mutually acceptable hard currency. This can always  
24   be achieved bilaterally, but could also be administered  
25   by some kind of clearing house with responsibility for  
26   a defined physical region of the network. There is a  
27   potential problem here, unless the exchange value of an  
28   NCU is pegged to some hard currency. Otherwise, it  
29   will float erratically as the number of NCU's per  
30   network transaction can vary inversely with the  
31   exchange rate to hard currency, without changing the  
32   actual monetary worth of the network transaction. The

1 problem might however eventually resolve itself if the  
2 NCU becomes a stable, global currency in its own right.

3

4 To complete a transaction using this system, an  
5 ultimate client could first issue a request for some  
6 information. For the purpose of this example only, it  
7 will be assumed that this request is contained in a  
8 single packet. The intrinsic value of this packet  
9 would probably be zero but, in all cases, could not  
10 exceed a predetermined maximum accepted by the router  
11 (which may well be the machine of a network service  
12 provider, acting at this point as a client). Further,  
13 since this machine is probably not owned by the owner  
14 of the ultimate client machine, there would be no  
15 tariff added to the value of the packet. The router,  
16 now acting as a server, adds a tariff to the packet and  
17 passes it to the next router. This process is repeated  
18 across the network until the packet reaches the machine  
19 of the content provider that, somewhat confusingly, is  
20 at this point acting as a client. Hence, the content  
21 provider receives a request for information but becomes  
22 liable for the accrued value of the packet. This value  
23 will be relatively small, since it is only one packet  
24 (or, more generally in practice, a relatively small  
25 number of packets) and it has little or no intrinsic  
26 value in its information content. It can be thought of  
27 as analogous to the cost associated with a free-phone  
28 telephone number that businesses commonly use to  
29 attract enquiries from customers.

30

31 The machine of the content provider now acts in its  
32 primary role as a server, and starts to send packets

1 addressed to the machine of the ultimate client (i.e.  
2 the machine from which the original request for data  
3 originated). Since the packets have content that is  
4 deemed to have some worth, these packets now have a  
5 significant value associated with them even as they are  
6 dispatched from the server machine. As they traverse  
7 the network, they will accrue further value until they  
8 reach the ultimate client machine. Routers within the  
9 network will have added value to packets passing both  
10 ways, so that owners of these machines will be in  
11 residual credit after paying for the packets received  
12 and will therefore be able to reclaim hard currency  
13 converted from NCU's to finance their activities. The  
14 content providers will have some liabilities for the  
15 receipt of the packets requesting data but will have a  
16 large residual credit for supplying the information.  
17 The ultimate client will contribute the majority of the  
18 payments due, which cover the cost of the information  
19 they receive and the cost of the process of  
20 transporting it to them.

21

22 The way in which a network router might implement the  
23 PTP, in addition to its existing transport protocol,  
24 for the purposes of transferring data packets and  
25 accumulating the associated tariffs, is illustrated in  
26 the flow chart of Fig. 3. The branches in the flow  
27 chart show possible contingencies at various stages, if  
28 the required conditions are not satisfied.

29

30 The router receives 30 a data packet and checks 32  
31 whether the packet is acceptable under the existing  
32 transport protocol. The router also checks 32 whether

1 the routing tables with which it is provided can  
2 resolve the address to yield the hardware connection  
3 along which the packet is to be dispatched. If the  
4 packet is acceptable and the address can be resolved  
5 the router proceeds to step 36. If the packet is not  
6 acceptable or the address cannot be resolved the router  
7 rejects 34 the packet.

8

9 The router then checks 36 that the value of the packet  
10 as determined from the value field 5 is below the value  
11 limit acceptable from the incoming hardware connection.  
12 If the value of the packet is not below the value limit  
13 the router rejects 38 the packet under the PTP rules.  
14 If the value of the packet is below the value limit the  
15 router proceeds to the next step, in which the recorded  
16 total value received from this hardware connection is  
17 incremented 40 by the value of the packet. The  
18 recorded total value received is stored by the router.

19

20 The router then calculates 42 the value to be added for  
21 the service of transmitting this packet along the  
22 particular hardware connection designated by the  
23 routing tables. This might depend upon the  
24 infrastructure of the hardware connection, the  
25 prevailing network loading, the time of day and many  
26 other factors. The router then increments 44 the  
27 packet's value field 5 which is the packet's internal  
28 record of its own value by this calculated value.

29

30 The router then transmits 46 the packet along the  
31 hardware connection along which the packet is to be  
32 dispatched. Following transmittal the router checks 48

1    that the recipient machine has acknowledged successful  
2    transfer of the packet (assuming the transfer protocol  
3    supports this). If the transfer is not successful,  
4    then this is handled under the existing transport  
5    protocol 50. If the transfer is successful the router  
6    increments 52 the recorded total value transmitted to  
7    this hardware connection by the value of the packet.  
8    The recorded total value transmitted is stored by the  
9    router.

10

11   For each router or hardware connection, the total value  
12   transmitted minus the total value received (e.g. in  
13   Network Credit Units) is the net profit (or loss) that  
14   must be reconciled with the owner of the machine at the  
15   other end of that hardware connection. This is used to  
16   determine the economic value of the accumulated  
17   transactions and forms the basis of the hard currency  
18   exchanges necessary to finance the activities and the  
19   provision of the infrastructure.

20

21   Physical network connections can be created and re-  
22   arranged relatively easily and network service  
23   providers can normally be changed at will. It is  
24   therefore anticipated that the kind of business system  
25   envisaged by the present invention will lead to a very  
26   efficient market constituted of very many providers of  
27   connections and routing bandwidth who serve,  
28   collectively, a very large number of content providers  
29   and information consumers. For example, if the  
30   financial arrangements were controlled in this manner,  
31   it might reasonably be envisaged that the  
32   infrastructure would evolve to support video on demand.



1 This would be based upon an enormous supply of  
2 material, effectively a distributed archive of all the  
3 material ever produced. It would satisfy the market by  
4 the laws of supply and demand.

5

6 One of the major problems associated with any data  
7 distribution, and particularly digital data, is that of  
8 unauthorized redistribution. Matters of privacy and  
9 security are also general problems in the context of  
10 the Internet. For the purposes of the description of  
11 the invention, it is necessary only to consider whether  
12 the use of PTP implies any changes as compared to the  
13 situation at present. The system of the invention does  
14 not require transfer of data in ways other than those  
15 presently possible, and the proposed protocol of the  
16 invention would not inhibit any of the security or  
17 encryption methods used to prevent such unauthorised  
18 redistribution. In fact, security and encryption would  
19 be expected to take place at the level of the data  
20 within the packet stream, rather than acting at the  
21 packet level itself.

22

23 One important feature of the system of the invention is  
24 that it allows consumers to choose exactly what they  
25 require without having to pay for unwanted accompanying  
26 material. For example, they can select one track  
27 without having to pay for a complete music CD, or they  
28 can decide not to view the remainder of a film if they  
29 dislike the opening portion. Also, the purchase price  
30 should be subject to very keen competition. These  
31 facts in themselves mean that there is less temptation  
32 to acquire material from illegal sources. Any legal

1     deterrents become more effective if individuals can buy  
2     selectively only what they actually require, and at a  
3     fair price.

4

5     In addition, as individuals are presented with, and  
6     begin to utilize, the much greater choice of available  
7     information, their interests will rapidly diversify and  
8     their requirements will diverge. This will have the  
9     effect of making it more difficult to cache data as it  
10    passes through the network and resell it multiple  
11    times. If content becomes sufficiently cheap, it will  
12    not be worth the investment in hardware to cache it.  
13    There will be less demand for any particular content,  
14    so that the logistics of illegal storage for reselling  
15    become more expensive and therefore less attractive.  
16    This is not to say that a legal business of caching and  
17    reselling popular information could not build up, still  
18    within this framework. This could, for example, be how  
19    what are now broadcast services continue to make money.  
20    Network capacity will need a large step-change before  
21    commonly required content can be served to all clients  
22    from a single source, a matter which is presently  
23    addressed by the use of network caches, proxy servers  
24    and mirror sites on the Web. Such issues are tied in  
25    with copyright and ownership of content. For example,  
26    it is not generally possible for an end-user to tell  
27    whether content comes from its original provider or  
28    from some legitimate or illegitimate cache. Once  
29    again, the implementation of the system of the  
30    invention would not impact upon these matters of  
31    copyright and ownership of content.

32

1 The system of the invention as described above can also  
2 function with the concept of the network computer,  
3 which for example means that a user might have the  
4 option of purchasing the use of a software application  
5 for some period rather than actually buying the  
6 application outright. Once again, they receive (and  
7 pay for) only what they actually require, and always  
8 get the most up to date version so that rapid  
9 obsolescence is not a concern.

10

11 One other important feature of the PTP concept is that  
12 it can be interfaced with a conventional network,  
13 operating under a different business model, provided  
14 charging rates and so forth are agreed for the  
15 interfaces. This means that network fragments can be  
16 created or converted to conform to the PTP model as and  
17 when suits the infrastructure owner, so that gradual  
18 conversion is possible and a massive "roll-out" program  
19 is unnecessary.

20

21 It is possible that, for effective operation, the  
22 system of the invention will require international  
23 financing deals and clearing arrangements, as well as  
24 software controlled real-time network configuration  
25 changes and real-time pricing structure changes.  
26 However, the system of the invention offers two  
27 significant advantages, as follows. Firstly, the  
28 ultimate client always has transparent data on what the  
29 service being received is actually costing, over any  
30 desired time interval. This is regardless of the  
31 choice of information source, network service or demand  
32 driven costing changes. Secondly, PTP represent a good

1 approximation to a perfectly competitive and efficient  
2 market, and one in which the costs and revenues are  
3 intimately related at all stages to the actual  
4 activities from which they result. These features  
5 should be expected to encourage serious investment into  
6 infrastructure development.

7  
8 Particular details of a method of implementing PTP in a  
9 TCP/IP environment will now be described. In  
10 particular, for the value quantity to be directly  
11 accessible for processing by the routers, the value  
12 field must be contained in the IP Layer header. This  
13 is because the TCP Layer header is considered purely as  
14 data by the routers that implement IP protocols and, as  
15 such, it is to be transported without any reference to  
16 its contents. However, for the value field to be  
17 useful to individual client and server applications for  
18 the purpose of enumerating the intrinsic worth of the  
19 data being transported, it must be accessible to these  
20 applications. The applications operate at the  
21 Application Layer of the TCP/IP stack and this layer  
22 interfaces with the TCP Layer, with the IP Layer being  
23 effectively invisible to the application. The matter  
24 is further complicated by the existence of UDP (User  
25 Datagram Protocol), which provides an alternative  
26 protocol at the Transport Layer (and there might be  
27 additional alternatives, which either currently exist  
28 or will be defined in the future). The invention  
29 proposes three solutions to this, as follows.  
30  
31 The first solution is to have separate value fields.  
32 According to this solution there are two distinct value

1 fields, one in the IP Layer, to accrue measurement of  
2 the economic worth of performing the data transport  
3 operation, and one in the Transport Layer, to enumerate  
4 the intrinsic worth of the data. Such a solution does  
5 not allow the unification of the methods covering the  
6 two contributions to the economic model, and so is not  
7 the preferred solution.

8

9 The second solution is direct communication between the  
10 application and the IP Layer. Such communication can  
11 be hazardous with respect to the structure and  
12 implementation of the TCP/IP protocol and is not  
13 generally considered to be a realistic solution. There  
14 is a useful exception in the case of an "information  
15 server", a system dedicated to serving information on  
16 behalf of a content provider and which is accessed by a  
17 client dedicated to the task of receiving that  
18 information. A server in such a system can run  
19 customised application software, in which the direct  
20 access to the IP Layer is available as required. The  
21 client works solely with the incoming information, so  
22 that the resources consumed (and measured in accordance  
23 with PTP) on behalf of the client application are  
24 indistinguishable from the total resources consumed by  
25 the client machine. This is the maximum level of  
26 detail that could be measured if the PTP values were  
27 accessed directly from the IP Layer, since IP does not  
28 work with reference to specific ports or the individual  
29 applications which are notionally attached to them.

30

31 The third, most favoured solution is integration with  
32 the Transport Layer. The PTP value field is

1 incorporated in the IP Layer header. The Transport  
2 Layer protocol (TCP, UDP or other) is aware of the  
3 value field and can convey the information to and from  
4 the Application Layer as required, even though this  
5 information is not written in the Transport Layer  
6 header and thus not considered to be conveyed at the  
7 Transport Layer level. The act of reading and writing  
8 the value field would still be expected to be the  
9 preserve of the of the IP Layer implementation  
10 software. This structuring appears to be analogous to  
11 the way in which applications can have access to IP  
12 addresses, although these are actually written in to,  
13 and read back from, the IP headers.

14  
15 Practical details in implementing the router  
16 functionality required by the PTP system will now be  
17 described. Incrementing the value field does not  
18 impose an unacceptable processing overhead on the  
19 router. There is a precedent for this kind of  
20 processing in the way that the IP standard defines and  
21 utilises a time-to-live (TTL) value in the IP header.  
22 This is subject to a decrement each time a router hop  
23 occurs. This capability can be extended to include a  
24 simple addition to the value field at the same point in  
25 the processing. This operation is likely to be an  
26 integer addition or binary add function on a specific  
27 bit field in the packet header, a relatively  
28 straightforward procedure. At the same time  
29 developments in hardware technology will go some way to  
30 compensating for the increased burden placed upon the  
31 network infrastructure by the implementation of PTP.  
32 Dedicated hardware may be used to support the value

1 field modification. Since there is an intimate  
2 relationship between the physical network connections  
3 and the particular value of the increment to be  
4 applied, an appropriate piece of equipment can be  
5 placed "in line" on each physical network connection,  
6 to perform the task. Such a unit can respond to its  
7 own communications protocol (something akin to the way  
8 routers work with ICMP (Internet Control Message  
9 Protocol), ARP (Address Resolution Protocol) and RARP  
10 (Reverse Address Resolution Protocol)) to receive  
11 updates to the algorithm for the value to be added to  
12 passing packets and also to return accumulated totals  
13 at appropriate times. Otherwise it operates as a  
14 standalone piece of network infrastructure, logging and  
15 incrementing the values of passing packets. Such a  
16 configuration alleviates the need for routers to  
17 allocate the accumulating values to particular network  
18 connections or IP addresses in real time, as they  
19 process the packets.

20  
21 In addition, it is also possible that, rather than each  
22 and every router performing its own increment to the  
23 value field, a more "coarse grained" implementation of  
24 the PTP model could be applied. This would occur if  
25 the provider of a particular piece of infrastructure  
26 were willing to consider that piece of infrastructure  
27 (e.g. an optical fibre "backbone") as a zone and  
28 therefore apply a more straightforward tariff for  
29 transportation across the zone. This would mean that  
30 the logging and increasing of the value fields of  
31 packets transported across the zone would only need to  
32 take place at the zone boundaries. This scheme is

1 effectively equivalent to considering the flow chart of  
2 Fig. 3 to apply to a network zone rather than an  
3 individual router.

4

5 These and other modifications and improvements can be  
6 incorporated without departing from the scope of the  
7 invention.



## 1 CLAIMS

2

3 1. A method of electronic payment for data  
4 transferred across a computer network containing at  
5 least one client, at least one server and at least one  
6 router which forwards data, the method comprising the  
7 steps of:

8 sending an electronic data request from a client  
9 to a server via one or more routers; and

10 sending electronic data from said server to said  
11 client via one or more routers in response to said  
12 electronic data request, said electronic data having  
13 associated with it a data field containing a value  
14 which represents the commercial value of the data  
15 contained within the electronic data.

16

17 2. A method according to Claim 1 in which the  
18 electronic data is transmitted in the form of packets.

19

20 3. A method according to Claim 2, wherein each of  
21 said one or more routers receives an incoming data  
22 packet, reads the value in the data field associated  
23 with the incoming data packet, calculates a new value  
24 based on the read value and the cost of forwarding the  
25 data packet, and forwards the data packet with the new  
26 value in the associated data field.

27

28 4. A method according to Claim 3, wherein each of  
29 said one or more routers checks whether the value in  
30 the data field associated with the incoming data packet  
31 falls within predefined parameters and rejects the

1 packet if the value falls outside the predefined  
2 parameters.

3

4 5. A method according to any preceding Claim, wherein  
5 the electronic data request has associated with it a  
6 data field containing a value which represents the  
7 commercial value of the data contained within the  
8 electronic data request.

9

10 6. A method according to any preceding Claim, wherein  
11 total accumulated values for transactions between  
12 routers or between routers and servers/clients are  
13 recorded.

14

15 7. A method according to Claim 6, wherein clearance  
16 payments are made between the operators and/or users of  
17 the routers and servers/clients, the clearance payments  
18 corresponding to the total accumulated values.

19

20 8. A system of electronic payment for data based on a  
21 hardware infrastructure of linked routers, data  
22 providers and data users, comprising:

23 at least one client;

24 at least one server for providing electronic data  
25 in the form of data packets in response to a request  
26 from a client and having its operation governed by a  
27 server protocol which causes each data packet sent by  
28 the server to have associated with it a data field  
29 representing the value of the data contained within the  
30 packet;

31 at least one router linked by a hardware  
32 infrastructure to said server and said client and

1 having its operation governed by a routing table and a  
2 router protocol;

3 whereby the router protocol causes each router to  
4 add commercial value to the packet by forwarding it in  
5 accordance with the routing table and to update the  
6 value contained in the data field within the packet to  
7 reflect this added commercial value.

8

9 9. A system according to Claim 8, wherein the router  
10 protocol also includes procedures for rejecting  
11 individual packets in accordance with pre-defined  
12 parameters related to the value of each packet on  
13 receipt.

14

15 10. A method of electronic payment for data  
16 transferred across a computer network containing at  
17 least one client, at least one server and at least one  
18 part of the network which forwards data, the method  
19 comprising the steps of:

20 sending an electronic data request from a client  
21 to a server via the part of the network; and

22 sending electronic data from said server to said  
23 client via the part of the network in response to said  
24 electronic data request, said electronic data having  
25 associated with it a data field containing a value  
26 which represents the commercial value of the data  
27 contained within the electronic data.

28

29 11. A method according to Claim 10 in which the  
30 electronic data is transmitted in the form of packets.

31

1 12. A method according to Claim 11, wherein the part  
2 of the network has an associated data processor which  
3 reads the value in the data field associated with an  
4 incoming data packet received by the part of the  
5 network, calculates a new value based on the read value  
6 and the cost of forwarding the data packet, and  
7 forwards the data packet with the new value in the  
8 associated data field.

9  
10 13. A method according to Claim 12, wherein the data  
11 processor checks whether the value in the data field  
12 associated with the incoming data packet falls within  
13 predefined parameters and rejects the packet if the  
14 value falls outside the predefined parameters.

15  
16 14. A method of electronic payment for requested data  
17 transferred across a computer network containing at  
18 least one client, at least one server and at least one  
19 router which forwards data, in which the requested data  
20 is sent from said server to said client in the form of  
21 a packet,

22 wherein said packet comprises a packet header and  
23 packet data,

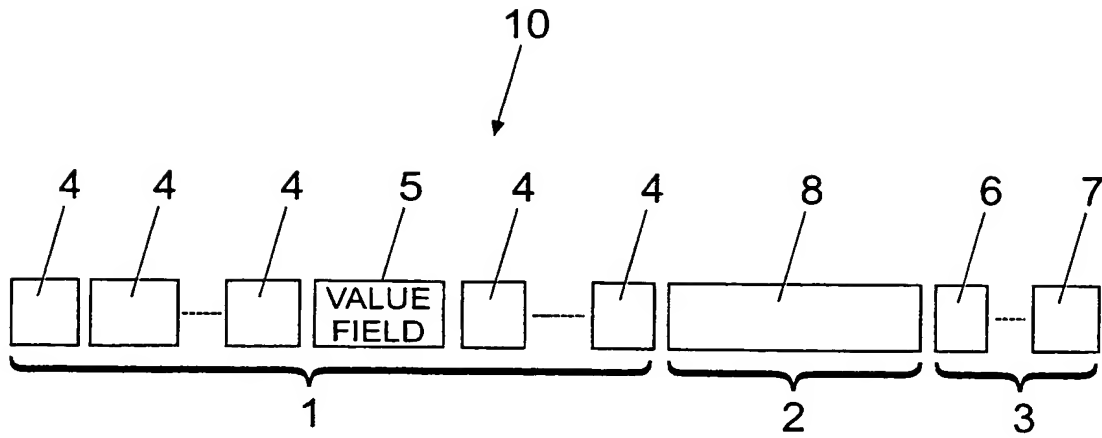
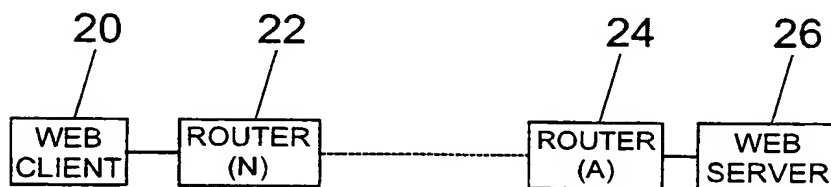
24 the packet data containing the requested data, and  
25 the packet header containing one or more address  
26 fields containing address information relating to the  
27 client and/or server and a data field containing a  
28 value which represents the commercial value of the  
29 requested data contained within the packet data.

30

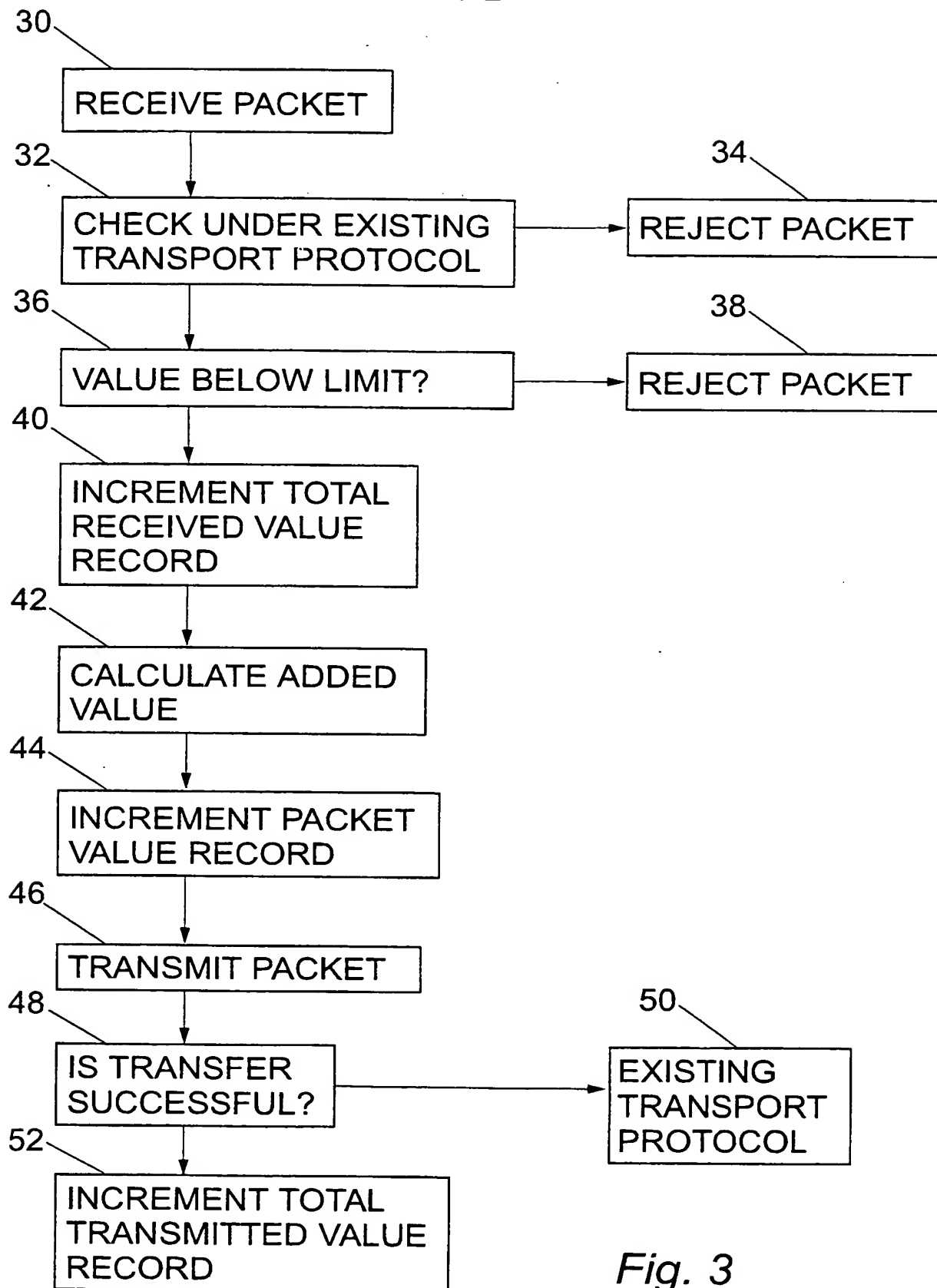
31 15. A method according to Claim 14, wherein the data  
32 is sent via the router which reads the value in the

1 data field of the incoming data packet received by the  
2 router, calculates a new value based on the read value  
3 and the cost of forwarding the data packet, writes the  
4 new value to the data field, and forwards the data  
5 packet with the new value in the data field.

1 / 2

*Fig. 1**Fig. 2*

2 / 2

*Fig. 3*

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/02413

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 7 G07F17/16 G07F7/10 H04L12/14

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G07F H04L H04B G06F H04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	column 5, line 39 - line 57	2
A	column 6, line 6 - line 20	6
A	column 10, line 17 - line 21 ---	
A	EP 0 537 756 A (FUJITSU LTD) 21 April 1993 (1993-04-21) abstract; figure 1 column 4, line 9 - line 47 column 7, line 9 - column 8, line 43 ---	1,8,10, 14
A	US 5 754 787 A (DEDRICK RICK) 19 May 1998 (1998-05-19) claim 1 ---	1,8,10, 14
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

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Date of the actual completion of the international search

24 October 2000

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# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/02413

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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